UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS
AUSTIN DIVISION

AMERICAN STEWARDS OF LIBERTY, et al. Plaintiffs, v. UNITED STATES FISH & WILDLIFE SERVICE, et al. Federal Defendants.	§ § § § § § § §	No. 15-cv-1174-LY

FEDERAL DEFENDANTS' INDEX OF EXHIBITS IN SUPPORT OF THEIR CROSS-MOTION FOR SUMMARY JUDGMENT AND OPPOSITION TO PLAINTIFF-INTERVENORS' MOTION FOR SUMMARY JUDGMENT [DKT NO. 133]

Exhibit 1 - M003393-424

90-Day Finding on a Petition to Remove the Bone Cave Harvestman from the List of Endangered and Threatened Wildlife

Exhibit 2 – M003606-25

U.S. Fish and Wildlife Service, Why Save Endangered Species?

Exhibit 3 – M003626-32.

Comment by Dr. George Veni, Executive Director of the National Cave and Karst Research Institute.

Exhibit 4

General Land Office of the State of Texas v. U.S. Fish and Wildlife Serv. (W.D. Tex.), Case No. A-17-CA-538-SS, Dkt. No. 47 (Nov. 30, 2017)

Dated: December 15, 2017

Respectfully Submitted,

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Defense Exhibit 1

Endangered and Threatened Wildlife and Plants; 90-Day Finding on a Petition To Remove the Bone Cave Harvestman From the List of Endangered and Threatened Wildlife

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of 90-day petition finding.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce a 90-day finding on a petition to remove the Bone Cave harvestman (*Texella reyesi*) from the List of Endangered and Threatened Wildlife under the Endangered Species Act of 1973, as amended (Act). Based on our review, we find that the petition does not present substantial scientific or commercial information indicating that the petitioned action may be warranted. Therefore, we are not initiating a status review in response to this petition. However, we are in the process of conducting a species status assessment and 5-year status review and we invite the public, including the petitioners and other interested parties, to submit new data and information for consideration in this ongoing process. In particular, we ask the public to submit to us any new information that becomes available concerning the status of, or threats to, the Bone Cave harvestman or its habitat at any time.

SUPPLEMENTARY INFORMATION:

Background

Section 4(b)(3)(A) of the Act (16 U.S.C. 1531 et seq.) requires that we make a finding on whether a petition to add a species to ("list"), remove a species from ("delist"), or reclassify a species on the Lists of Endangered and Threatened Wildlife and Plants presents substantial scientific or commercial information indicating that the petitioned

action may be warranted. We are to base this finding on information provided in the petition, supporting information submitted with the petition, and information otherwise available in our files. To the maximum extent practicable, we are to make this finding within 90 days of our receipt of the petition and publish our notice of the finding promptly in the **Federal Register**.

The Services revised the regulations at 50 CFR 424.14 to clarify the procedures under which the Services evaluate petitions effective October 27, 2016 (81 FR 66462; September 27, 2016). We originally received the petition that is the subject of this document on June 2, 2014, with supplemental information received on October 5, 2016. We therefore evaluated this petition under the 50 CFR 424.14 requirements that were in effect prior to October 27, 2016, as those requirements applied when the petition and supplemental information were received.

Our standard for substantial scientific or commercial information with regard to a 90-day petition finding was "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted" (50 CFR 424.14(b)(1)). If we find that substantial scientific or commercial information was presented, we are required to promptly conduct a species status review, which we subsequently summarize in a 12-month finding.

Petition History

On June 2, 2014, we received a petition from John Yearwood, Kathryn Heidemann, Charles and Cheryl Shell, the Walter Sidney Shell Management Trust, the American Stewards of Liberty, and Steven W. Carothers requesting that we remove the endangered Bone Cave harvestman from the Federal List of Endangered and Threatened

Wildlife. The petition clearly identified itself as a petition and included the requisite identification information for the petitioners, as required at 50 CFR 424.14(a) (now 50 CFR 424.14(c)(1)). On June 1, 2015, the Service published a 90-day finding in the **Federal Register** (80 FR 30990) that the petition did not present substantial scientific or commercial information indicating that the petitioned action was warranted. On December 15, 2015, the American Stewards of Liberty, Charles and Cheryl Shell, Walter Sidney Shell Management Trust, Kathryn Heidemann, and Robert V. Harrison, Sr. challenged the 2015 90-day finding in Federal district court. The Service sought the court's permission to reconsider the 90-day finding. On December 22, 2016, the court ordered the Service to complete a new 90-day finding and deliver that finding to the **Federal Register** on or before March 31, 2017. This 90-day finding supersedes the Service's previous 2015 90-day finding, and is made pursuant to the court's December 22, 2016 order, the 2014 petition, and the additional reference materials accompanying the petition.

Previous Federal Actions

On September 16, 1988, the Service determined that the Bone Cave harvestman was endangered under the ESA (53 FR 36029). The 1988 final listing determination included five separate species, one of which was the Bee Creek Cave harvestman. Subsequent scientific studies concluded that the Bee Creek Cave harvestman actually consisted of two separate species: the Bee Creek Cave harvestman and the Bone Cave harvestman. As a result, the Service made a technical correction to include both species on the list of endangered species (58 FR 43818; August 18, 1993).On March 14, 1994, we published a 90-day finding (59 FR 11755) on a petition to delist the Bone Cave

harvestman in which we found that the petition did not present substantial scientific or commercial information indicating that the petitioned action may have been warranted. We developed a draft recovery plan on June 7, 1993, and made it final on August 25, 1994 (Service 1994b). On December 4, 2009, we completed a 5-year review of the Bone Cave harvestman, which recommended that the species remain listed as endangered (Service 2009). On June 1, 2015, we published a 90-day finding (80 FR 30990) on a petition to delist the Bone Cave harvestman which was subsequently withdrawn. This 90-day finding supersedes the Service's 2015 90-day finding. We announced our initiation of a 5-year review of the Bone Cave harvestman, and requested information for that review, on April 15, 2015 (80 FR 20241).

Species Information

For information on the biology and life history of the Bone Cave harvestman, see the final rule listing this species (53 FR 36029; September 16, 1988), the Endangered Karst Invertebrates Recovery Plan for Travis and Williamson Counties (Service 1994b), and the 5-year Status Review for the Bone Cave Harvestman (Service 2009), all posted at *http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=J009*. For information on preserve design and management for karst invertebrate species conservation, see the Karst Preserve Design Recommendations (Service 2012) and the Karst Preserve Management and Monitoring Recommendations (Service 2014) posted at *http://www.fws.gov/southwest/es/AustinTexas/ESA_Sp_KarstInverts.html*.

Evaluation of Information for This Finding

Under section 3(16) of the Act, we may consider for listing any species, including subspecies, of fish, or wildlife, or plants, and any distinct population segment of any

species of vertebrate fish or wildlife that interbreeds when mature (16 U.S.C. 1532(16)). Such entities are listed under the Act if we determine that they meet the definition of an endangered or threatened species.

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations at 50 CFR 424 set forth the procedures for adding a species to, or removing a species from, the lists of endangered and threatened species. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1) of the Act: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence.

We must consider these same five factors in delisting a species. We may delist a species according to 50 CFR 424.11(d) if the best available scientific and commercial data indicate that the species is neither endangered nor threatened for the following reasons: (1) The species is extinct; (2) The species is recovered; or (3) The original data for classification were in error. According to 50 CFR 424.11(d)(3), a species may be delisted when subsequent investigations "show that the best scientific and commercial data available when the species was listed, or the interpretation of such data, were in error."

In making this 90-day finding, we evaluated whether the petition presented substantial information indicating that the petitioned action (delisting) may be warranted. The petition did not assert that the Bone Cave harvestman is extinct, nor do we have

information in our files indicating that the species is extinct. The petition asserted that new information indicates that the original data, or our interpretation of the data, used in the listing of this species were in error. The petition also states that significant conservation has been put in place since the species was listed, such that the species is recovered.

In 2009, we conducted a 5-year status review of the Bone Cave harvestman (Service 2009). The purpose of a 5-year status review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on a 5-year review, we recommend whether a species should be removed from the List of Endangered and Threatened Wildlife, be changed in status from endangered to threatened, be changed in status from threatened to endangered, or remain at its current status. As part of the 2009 Bone Cave harvestman review, we evaluated whether the species had met the recovery criteria laid out in the species' recovery plan (Service 1994b, pp. 86–89).

Our Recovery Planning Guidance (NMFS and Service 2010) points out that recovery criteria should address the biodiversity principles of resiliency, redundancy, and representation (Schaffer and Stein 2000). Resiliency is the ability of a population or species to persist through severe hardships or stochastic events.

Redundancy refers to ensuring a sufficient number of populations to provide a margin of safety to reduce the risk of losing a species or certain representation (variation) within a species due to catastrophic events or other threats.

Representation involves conserving "some of everything" with regard to genetic and ecological diversity to allow for future adaptation and maintenance of evolutionary

potential. Representation and the adaptive capabilities (NMFS and Service 2010, p. 76994) of the Bone Cave harvestman are also important for long-term viability. Because a species' genetic makeup is shaped through natural selection by the environments it has experienced (Shaffer and Stein 2000, p. 308), populations should be protected in the array of different environments in which the invertebrate species occur as a strategy to ensure genetic representation, adaptive capability, and conservation of the species. Generally, the more representation, or diversity, the species has, the more it is capable of adapting to changes (natural or human-caused) in its environment.

The recovery plan for the Bone Cave harvestman (Service 1994b, pp. 86–88) identifies criteria for reclassification (from endangered to threatened), but does not include delisting criteria because we were unable to determine criteria for delisting the species at that time. Although meeting recovery criteria is not the standard for delisting, these reclassification recovery criteria are discussed here as a way of measuring our progress toward recovery and assessing the current status of the species. The recovery plan identifies two criteria for reclassifying the species from endangered to threatened: (1) Three karst fauna areas (if at least three exist) within each karst fauna region in its range are protected in perpetuity. If fewer than three karst fauna areas exist within a given karst fauna region, then all karst fauna areas within that region should be protected. (2) Criterion (1) has been maintained for at least 5 consecutive years with assurances that these areas will remain protected in perpetuity.

Karst fauna regions are geographic regions delineated based on geologic continuity, hydrology, and species distribution (Service 1994b, p. 76). There are six karst fauna regions in Travis and Williamson Counties, Texas, that are known to contain the

Bone Cave harvestman (Service 1994b, p. 33): North Williamson, Georgetown, McNeil/Round Rock, Cedar Park, Jollyville Plateau, and Central Austin. These regions are used as a way to facilitate conservation of representation and redundancy (as defined above) throughout the species' range.

Karst geologic areas were initially established for Travis and Williamson Counties, Texas, in 1992 (Veni & Associates 1992) and subsequently incorporated as karst fauna regions into the Recovery Plan for Endangered Karst Invertebrates in Travis and Williamson Counties, Texas (Service 1994b, pp. 28-34). Karst species zones, geographic areas used to denote the potential for listed karst invertebrate occurrence, were revised in 2007 for Travis and Williamson Counties, Texas (Veni and Martinez 2007). That revision incorporated additional species occurrence data and more robust geological mapping, and provided a more refined assessment of species distribution. While some studies suggest specific karst fauna regions could be redefined (Paquin and Hedin 2004, p. 3250; White 2006, pp. 93-99), they remain an overall suitable conservation strategy to aid in species recovery (Veni and Martinez 2007, p. 25; Ledford *et al.* 2012, p. 12).

For the purposes of the recovery plan, a karst fauna area "is an area known to support one or more locations of a listed species and is distinct in that it acts as a system that is separated from other karst fauna areas by geologic and hydrologic features and/or processes that create barriers to the movement of water, contaminants, and troglobitic fauna" that live their entire lives underground (Service 1994b, p. 76). Karst fauna areas should be far enough apart so that if a catastrophic event (for example, contamination of the water supply, flooding, disease) were to destroy one of the areas, that event would not

likely destroy any other area occupied by that species (Service 1994b, p. 76).

To be considered "protected," a karst fauna area must be sufficiently large to maintain the integrity of the karst ecosystem on which the species depends (Service 1994b, p. 87). In addition, these areas must also provide protection from threats such as red imported fire ants, habitat destruction, and contaminants.

The overall recovery strategy for the Bone Cave harvestman includes the perpetual protection and management of an adequate quantity and quality of habitat (three karst fauna areas in each karst fauna regions) that spans the species' geographic range and provides a high probability of the species' recovery and survival over the long term. Adequate quality (as discussed below) and quantity of habitat refers to both size and number of preserved karst fauna areas that are sufficient for supporting the karst invertebrates and the ecosystems upon which they depend (Service 2011, p. 16). The recovery plan criteria call for three karst fauna areas (preserves) in each karst fauna region. The size of karst fauna area preserves should be large enough to ensure resiliency, as discussed above, and to protect the environmental integrity of the karst ecosystems upon which the species depends. The number of karst fauna area preserves called for in the recovery criteria provides redundancy for the species. A minimal level of redundancy within areas representing differing ecological and genetic makeup is essential to provide a margin of safety for the species to reduce the risk of losing the species or representation (variation) within the species from catastrophic events or other threats (Shaffer and Stein 2000 pp. 307, 309–310; Groves *et al.* 2002, p. 506). The Bone Cave harvestman has significant geographic variability across its range, and loss of a significant number of locations in part of its range could result in loss of genetic and

ecological diversity. The conservation of multiple karst fauna area preserves across the Bone Cave harvestman's range should provide representation of the breadth of its genetic and ecological diversity to conserve its adaptive capabilities (Schaffer and Stein 2000, p. 308).

Adequate quality of habitat refers to (1) the condition and configuration of preserved lands with respect to the known localities for the species, and (2) the ability of the species' needs to be met to sustain viable populations. Due to the uncertainty in determining population viability of the Bone Cave harvestman, the design of preserves for its protection should be based on estimates and assumptions that favor a high probability for recovery of this species and the ecosystems upon which it depends as discussed below.

The Endangered Karst Invertebrates Recovery Plan for Travis and Williamson Counties (Service 1994b) calls for protecting karst fauna areas sufficiently large to maintain the integrity of the karst ecosystem on which the species depends. This focus on the ecosystem is consistent with the purposes of the Act, which include "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" (16 U.S.C. 1531(b)). Therefore, we recommend designing karst fauna area preserves to protect occupied karst feature(s) and associated mesocaverns (humanly impassable voids). For further guidance on how to provide for adequate quantity and quality of habitat at specific invertebrate locations, we have developed and refer to our Karst Preserve Design Recommendations (Service 2012).

According to our preserve design guidelines (Service 2012, p. 3-5), karst fauna area preserves should include the following: (1) Surface and subsurface drainage basins

of at least one occupied cave or karst feature; (2) a minimum of 16 to 40 hectares (ha) (40 to 100 acres (ac)) of contiguous, unfragmented, undisturbed land to maintain native plant and animal communities around the feature and protect the subsurface karst community; (3) 105-meter (m) (345-feet (ft)) radius of undisturbed area from each cave footprint for cave cricket foraging (cave crickets are an important source of nutrient input to the karst ecosystem) and to minimize deleterious edge effects; and (4) preserves free of pipelines, storage tanks, or other facilities (for example, water retention ponds) that could cause contamination.

Because of the difficulties determining the population viability and habitat requirements for Bone Cave harvestman, this method follows a precautionary approach, which provides guidance to avert irreversible risk when facing uncertainty (Service 2012, p. A-1). Life-history characteristics of this species indicate that it requires stable temperature and humidity (Barr 1968, p. 47; Mitchell 1971, p. 250), and suggest that this species cannot be reintroduced because it cannot withstand surface climatic conditions.

According to anecdotal reports provided to our Austin Ecological Services Field Office, limited efforts to maintain karst invertebrates in a lab setting have been unsuccessful. Additionally, captive propagation techniques have not been developed for karst invertebrates and may be challenging to develop because of their specific adaptations to subterranean environment. Further, the sample size that would likely be needed to reintroduce a population into a new location cannot be obtained from existing populations due to the cryptic nature of this species and the fact that often only a few individuals are observed per cave survey. Therefore, an attempt to re-establish a population after it has been extirpated is not feasible at this time. In addition, if a

preserve is later found to be insufficient to support the species due to surrounding developments being either too close or too dense, the potential for adequately conserving the site is lost.

Because the Bone Cave harvestman has a relatively long life span and low requirements for food, a decline in population size or even the complete extirpation of the population due to the influence of development or other threats may take years or even decades. Observations of this species over several years on a preserve that is too small for perpetual species preservation may not allow detection of declines that are actually occurring. If these observations are used as evidence that a preserve size was adequate, then the potential for long-term preservation of the species may be lost due to irreversible development surrounding the preserve. Therefore, preserve sizes should be established with caution and be large enough to account for the uncertainty in area requirements for a population.

According to the petition, there are now more known occupied locations identified; there were 6 confirmed caves at listing; 60 confirmed caves at the time the recovery plan was drafted; and 168 confirmed caves in 2009, when the 5-year status review was completed (53 FR 36029, September 16, 1988; Service 1994b, 2009). The petition also states that more locations are likely to be found. We acknowledge that there are more known locations since the time those documents were completed and that the increase is likely an increase in our knowledge, not a true increase in the number of populations or range; however, species are listed under the Act based on an overall assessment of their viability and threats to their continued existence and not a simple assessment of the number of sites or size of the species' range. Some of the ongoing

threats to the species include habitat loss to development, alteration of drainage patterns, alteration of surface plant and animal communities, and contamination.

The petition states that 94 karst preserve areas are currently providing significant conservation. While these karst preserve areas are an important tool for preserving the current population of Bone Cave harvestman, many of the existing protected areas referenced in the petition are too small to meet the Service's preserve design recommendations. As part of the 2009 5-year status review of the Bone Cave harvestman, we reviewed the status of all of the known locations of the harvestman (including 83 of the 94 mentioned in the petition) to assess whether the criteria from the recovery plan to reclassify the species from endangered to threatened had been met for the Bone Cave harvestman. We considered the habitat size and condition to evaluate whether the locations could meet the preserve design recommendations (a reflection of the potential to support a resilient population) and then also looked at whether legally binding mechanisms were in place to provide protection of these sites over the long term (in perpetuity).

Of the locations known at the time of the 5-year review, 21 areas appeared to have the potential to meet the preserve design criteria. Our status review refers to 21 areas, while the petition incorrectly indicates that the status review considered 28 sites. This discrepancy is because the petition considers each individual cave location, while our status review considered closely located caves to be part of the same karst fauna area. Of these 21 areas, 1 is no longer confirmed to have the species (Barker Ranch Cave No. 1), and 5 are now protected karst fauna areas (Priscilla's Well, Twin Springs, Cobbs Cavern, Karankawa, and Tooth Cave).

In addition, at most of the remaining locations (of the 21 areas), we lack information to confirm that they meet the preserve design criteria (such as whether the surface and subsurface drainage basins are protected; tract acreage; exact locations of the cave within the area; and management activities to protect against threats, such as red imported fire ants). Also, many of these areas do not have a legally binding mechanism that ensures perpetual protection and management. Hence, we are unsure whether those areas have adequate undeveloped acreage, management, or protection mechanisms to ensure the long-term protection and survival of the Bone Cave harvestman.

Of the five protected karst fauna areas that meet preserve design criteria, four occur in the North Williamson County Karst Fauna Region and one occurs in the Jollyville Plateau Karst Fauna Region. However, this species occurs in six karst fauna regions, and four of these have no protected karst fauna areas that are confirmed to meet preserve design recommendations. Therefore, the best available information indicates that the criteria for reclassification from endangered to threatened for this species have not been met, nor has adequate redundancy and representation (three karst fauna areas in each karst fauna region) been protected throughout the species' range, leaving the species vulnerable to existing threats including habitat destruction.

The petition asserts that four additional locations are known since the time of the 5-year review. However, the petition does not provide adequate information that would support whether these four additional locations are in a condition to meet preserve design recommendations. Based on information in our files, we are aware of one additional cave since the 5-year review that may meet preserve design recommendations in the North Williamson Karst Fauna Region; however, it is privately owned, and we are unsure about

the property acreage and if the site receives any type of protection or management. Regardless, the amount of protected karst fauna area still falls short of the criteria for reclassification from endangered to threatened.

Further, we reviewed 83 of the 94 caves identified in the petition as receiving some level of protection in the 5-year review. Two of the caves that we did not review (Cobbs Cavern and Whitney West Cave) are now in confirmed karst fauna areas mentioned above (Cobbs Cavern and Twin Springs); one (Pond Party Pit) is in the Beard Ranch Cave area discussed in the 5-year review; and we have no locality information or taxonomic verifications for the remaining caves, and this information was not provided in the petition.

The petition also asserts that threats to the species are not as severe as originally thought. We evaluate that information, below, with respect to the five listing factors.

Factor A: The present or threatened destruction, modification, or curtailment of the species' habitat or range. In the 1988 listing rule (53 FR 36029), we stated that the primary threat to the Bone Cave harvestman was the potential loss of habitat due to development activities, which could result in filling in or collapsing of caves; alteration of drainage patterns; increase in flow of sediment, pesticides, fertilizers, and urban run-off into caves; and increase in human visitation and vandalism.

We also considered additional information on threats to the species when we developed the recovery plan for the species (Service 1994b, pp. 59–65) and when we conducted the 5-year status review of the species (Service 2009, p. 2), in which we concluded that no change in the species' status (that is, reclassification to threatened or delisting) was warranted. We also reviewed available threat information in our files and

in a 1993 petition when we made our negative 90-day finding on that petition to delist (59 FR 11755; March 14, 1994).

The current petition asserts that "[d]evelopment activities on the surface may not result in the significant loss or degradation of habitat for *T. reyesi* as originally thought" and suggests that evidence of this is persistence of the species in caves surrounded by developed areas. Examples given in the petition are Inner Space Caverns, Sun City caves, Weldon Cave, Three-Mile Cave, and Four-Mile Cave. However, the observation of the species in these locations does not mean their populations at these locations are thriving or can withstand the long-term impacts from development activities that are expected to occur to karst invertebrate populations in developed areas, as discussed in the listing rule, recovery plan, and 5-year status review for the Bone Cave harvestman. In addition, increased development provides greater opportunities for contamination events such as pipeline leaks or hazardous material spills.

Bone Cave harvestman populations may be declining or threatened even though they are still observed at a specific site. The petition does not provide adequate information to detect population trends for this species and it is not available from other sources. This species has life-history strategies that include characteristics such as low metabolic and reproductive rates, long life spans, and inherently low sample sizes, which make it difficult to detect population response to possible impacts (Poulson and White 1969, p. 977; Howarth 1983, p. 374). We indicated in the 1994 90-day petition finding (59 FR 11755) that more time was needed to detect if the species was declining; however, while more time has passed, we are still lacking adequate data to conduct a trend analysis. It may be infeasible to assess karst invertebrate population trends in any

statistically significant manner given their association with humanly inaccessible cave habitat such as mesocaverns (Krejca and Weckerly 2007, p. 287). Human surveyors likely only have the opportunity to survey individuals from a subset of the available habitat (Knapp and Fong 1999, p. 6).

The petition states that several Sun City caves are examples of areas where the species can persist in developed areas. However, the petition failed to provide data adequate to assess trends in the karst invertebrate populations since the development occurred. In addition, we worked with the Sun City developers when they designed the project to develop strategies that we believed at the time would avoid or minimize the possibility of "take" of listed karst species. While we now believe that most of the Sun City cave preserves are too small to meet our preserve design recommendations for recovery and long-term survival (Service 2012), we expect that the strategies and conservation measures put in place likely have reduced the rate of impacts to the species.

The commercial cave known as Inner Space Caverns is another example the petition provided where the Bone Cave harvestman continues to persist in a developed area. Although the Bone Cave harvestman may be present at Inner Space Caverns, this does not ensure its populations are robust and secure; they may still be declining, and are at risk due to competition with surface-dwelling invertebrates and other threats associated with development, such as the potential for contamination. This cave has an overgrowth of blue-green algae growing near cave lights where the petition states that this species has been observed. This type of algae is known as "lampenflora" and favors surface-dwelling invertebrate species that can out-compete karst invertebrate species (Mulec and Kosi 2009, p. 109; Culver 1986, p. 438), such as the Bone Cave harvestman. The petition

failed to provide any data adequate to assess trends in the karst invertebrate population in relation to the time (duration and frequency) that they have been exposed to the artificial lighting. Additionally, part of the cave footprint occurs under a major interstate highway and train tracks, both of which present a threat of a contaminant spill that could impact the species in the future.

Weldon Cave was another example in the petition of a cave occupied by the Bone Cave harvestman within a developed area. Based on the best available information in our files, this cave is surrounded by undeveloped open space. Other than a small portion of the subsurface drainage basin potentially being impacted by a school campus, this cave appears to meet our preserve design recommendations but is not within a developed area, as asserted in the petition. Three-Mile Cave and Four-Mile Cave were also provided in the petition as examples of developed caves wherein the Bone Cave harvestman is known to occur. According to the petition, surveys conducted by SWCA in 2008 and 2009 documented the Bone Cave harvestman at these locations. However, detailed survey data were not provided by the petitioners and were not in the SWCA 2009 "Annual Report of Activities Involving Endangered Karst Invertebrates under Threatened and Endangered Species Permit TE800611–2."

The petition also states that, since the Bone Cave harvestman uses mesocaverns, it is protected from surface development activities because mesocaverns are "geologically protected." We are unclear why the petition contends that mesocaverns are protected because mesocaverns are subject to rapid permeation of surface water (Cowan *et al.* 2007, p. 160), and karst landscapes (including mesocaverns) are particularly susceptible to groundwater contamination because water penetrates rapidly through bedrock conduits

providing little or no filtration (White 1988, p. 149).

One of the major threats to the Bone Cave harvestman is habitat loss due to increasing urbanization. The Bone Cave harvestman is a troglobite, meaning it lives its entire life underground. Karst ecosystems are heavily reliant on surface plant and animal communities for nutrient input.

Caves in central Texas that are occupied by federally listed karst invertebrates, such as the Bone Cave harvestman, receive energy (or nutrients) primarily from (1) detritus (decomposing organic matter) that falls or is washed into the caves, and (2) energy brought into the caves by cave crickets (*Ceuthophilus* spp.) (Barr 1968, p. 48; Reddell 1993, p. 2; Lavoie *et al.* 2007, p. 114; Taylor *et al.* 2003, p. 3; 2004, p. 2; 2005, p. 97), which are found in most Texas caves (Reddell 1966, p. 33). Cave crickets forage widely in the surface habitat surrounding the cave. Karst invertebrates feed on the cave cricket eggs (Mitchell 1971, p. 251), feces (Barr 1968, pp. 51–53, Poulson *et al.* 1995, p. 226), and directly on the crickets themselves (Elliott 1994, p. 15).

Development within urbanized areas can destroy or alter the surface plant and animal communities on which karst invertebrates depend. As development increases within the cave crickets' foraging area, there may be dramatic shifts in the available food supply within the cave (Taylor *et al.* 2007, p. 7). The leaf litter and other decomposing material that make up most of the detritus from the surface plant and animal community may also be reduced or altered, resulting in a reduction of nutrient and energy flow into the cave. A study by Taylor *et al.* (2007) compared caves in urbanized areas that were impacted by development to those in natural areas and found that, even though a small area within a largely urbanized ecosystem may support a cave community where karst

invertebrates are occasionally seen, these populations are significantly lower than those found in caves in more natural, less developed ecosystems, most likely as a result of reduced nutrient input. Another study at Lakeline Cave in Travis County, Texas, was conducted in association with the issuance of a habitat conservation plan and accompanying section 10(a)(1)(B) permit issued for Lakeline Mall. That study is based on data collected from 1992 through 2011, which documented a significant decline during that 20-year timeframe in another endangered karst invertebrate, the Tooth Cave ground beetle (*Rhadine persephone*), and cave crickets as development increased (ZARA 2012, pp. 8, 10, 12). Further, at Lakeline Mall Cave, no more than three Bone Cave harvestmen have been observed during any single survey (ZARA 2012, p. 11). Also, no Bone Cave harvestmen were seen during 6 years (1993, 1999, 2001, 2006, 2009, and 2010) and 12 surveys in Lakeline Mall Cave (ZARA 2012, p. 11).

Available information in our files supports our projection in the 1988 listing rule (53 FR 36029) that development and human population would continue to increase within the range of the species. The population of the City of Austin grew from 251,808 people in 1970, to 735,088 people in 2007 (City of Austin 2007). This represents a 192-percent increase over the 37-year period. Population projections from the Texas State Data Center (2012, pp. 496–497), estimate that Travis County will increase 94 percent in population from 1,024,266 in 2010, to 1,990,820 in 2050. The Texas State Data Center also estimates an increase in human population in Williamson County from 422,679 in 2010, to 2,015,294 in 2050 representing a 377-percent increase over a 40-year timeframe. All human population projections from the Texas State Data Center presented here are under a high-growth scenario, which assumes that migration rates from 2000 to 2010 will

continue through 2050 (Texas State Data Center and the Office of the State Demographer 2012, p. 9). Urbanization and human population growth and development were identified as a threat in the original 1988 listing rule and continue to represent a threat to the species.

Factor B: Overutilization for commercial, recreational, scientific, or educational purposes. In the 1988 listing rule for the Bone Cave harvestman (53 FR 36029), we did not identify any threats under this factor. Likewise, the petition and our review of the information in our files did not identify any threats under this factor.

Factor C: Disease or predation. In the 1988 listing rule (53 FR 36029), we stated that increased human population increases the threat of predation by and competition with exotic (nonnative) and native surface-dwelling species, such as sow bugs, cockroaches, and red imported fire ants. The petition states that "[r]ecent studies suggest that fire ants may not present as significant or as lasting of a threat to the species as originally believed." The information cited regarding red imported fire ants is identified in the petition as an article by Porter and Savignano (1990), which we previously considered in our finding on the 1993 petition (59 FR 11755; March 14, 1994), and another study by Morrison (2002). The petition states that "a subsequent study by Morrison in 2002 revisited the Porter and Savignano (1990) study area 12 years later and replicated their study."

Morrison (2002, pp. 2341, 2343–2344) found that arthropod communities had rebounded to pre-RIFA [red imported fire ant]-invasion levels and that all measures of native ant and other arthropod species' diversity had returned to pre-invasion levels. Red imported fire ants were still the most abundant ant species, but not nearly as abundant as

during the initial red imported fire ants infestation. He concluded that the impacts to arthropod communities by red imported fire ants might be greatest during and shortly after the initial invasion, but long-term impacts are likely not as significant as once believed. However, we note that Morrison (2002, p. 2342) also states that "it is quite likely that red imported fire ants did contribute directly or indirectly to the disappearance or reduction in numbers of species" and that their study "should not be interpreted as an indication that detrimental effects of invasive ants will simply disappear with time." In addition, this is not "new information" as we have already reviewed these articles and considered the information they provided in the Bexar County Karst Invertebrates Recovery Plan (Service 2011, p. 12) and in our Karst Preserve Management and Monitoring Recommendations (Service 2014, p. 3), which is applicable here as all central Texas endangered karst invertebrates have similar life-history characteristics, and one of the Bexar County invertebrates (the Cokendolpher Cave harvestman) is in the same genus (*Texella*) as the Bone Cave harvestman. In addition, red imported fire ants have been found within and near many caves in central Texas and have been observed feeding on dead troglobites, cave crickets, and other species within caves (Elliott 1992, p. 13; 1994, p. 15; 2000, pp. 668, 768; Reddell 1993, p. 10; Taylor *et al.* 2003, p. 3).

Factor D: The inadequacy of existing regulatory mechanisms. The 1988 listing rule (53 FR 36029) states that "there are currently no laws that protect any of these species or that indirectly address protection of their habitat." While the petition did discuss some new ordinances that appear to have been put in place since the time of listing, we do not have enough information to indicate whether or not these State and local ordinances provide enough protection from all threats to the Bone Cave harvestman

in perpetuity.

The petition states that "the regulatory landscape includes a number of measures contributing to the conservation of the species outside of the protections afforded by the Endangered Species Act of 1973, as amended." For example, they say that protections offered though the City of Austin are adequate to protect the species in Austin, Texas. In the course of our work, we have reviewed these regulations and understand that most caves that are defined by the City of Austin's Environmental Criteria Manual as a cave are provided a 46- to 91-m (150- to 300-ft) set-back area (City of Austin 2014, p. 13-3). However, a 46-m (150-ft) or 91-m (300-ft) set-back is not adequate to meet our preserve design criteria, does not protect the cave cricket foraging area, and potentially does not include the surface and subsurface drainage basins. Further, the City of Austin's regulations are not applicable across the full range of the Bone Cave harvestman because the species occurs in Travis and Williamson Counties, including areas outside the Austin city limits.

The petition states that the City of Georgetown Water Quality Management Plan for the Georgetown salamander will offer protection to the Bone Cave harvestman. They state that this plan encourages the use of best management practices to protect water quality at Georgetown salamander locations. However, there are few Bone Cave harvestman locations that occur near Georgetown salamander locations, so any protection offered to the harvestman would be limited. Further, it is not clear from the petition whether this mechanism is voluntary, regulatory, or is currently in effect. In addition, the petition did not provide enough detail for us to evaluate all benefits this plan would provide to the Bone Cave harvestman, and it appears that participation in this plan is at

least in part voluntary.

The petition states that the Texas Commission on Environmental Quality (TCEQ) Edwards Rules provide protection to recharge features on the Edwards Plateau and that this provides protection from pollution to the Bone Cave harvestman. In a discussion of Factor D in the Bexar County Karst Invertebrates Recovery Plan (Service 2011, p. 13), we state that "the TCEQ water quality regulations do not provide much protection to the species' habitat (see 65 FR 81419–81433 for more information). For example, while some TCEQ practices provide protection from water quality impacts, others, such as sealing cave entrances for water quality reasons, can harm karst invertebrates." Sealing cave entrances can be harmful by blocking off water (leading to drying) and nutrient input to the karst invertebrate habitat. In addition, not all of the caves and mesocaverns that the Bone Cave harvestman occurs in are considered recharge features and, therefore, would not receive some of the water quality protection measures. Also, not all locations of the Bone Cave harvestman are under the jurisdiction of the Edwards Rules.

Factor E: Other natural or manmade factors affecting the continued existence of the species. In the 1988 listing rule (53 FR 36029), we stated that this species is extremely vulnerable to losses because of its severely limited range and because of its naturally limited ability to colonize new habitats. We also stated that the very small size of the species habitat units and the fragile nature of cave ecosystems make this species vulnerable to even isolated acts of vandalism. The petition states, "Inner Space Cavern demonstrates that the species can persist in caves with frequent human visitation and may be more tolerant of related habitat modification than originally believed." They also provide Three-Mile Cave and Four-Mile Cave as examples of caves that have

experienced human use yet the species persists in them. The petition contends that, since the Bone Cave harvestman exists in Inner Space Caverns, human visitation is not a threat. The petition also states that Three-mile and Four-mile Cave had graffiti from the 1890s, 1920s, and 1950s. However, no detailed information was provided to demonstrate if these caves experienced continued human use. The petition also indicates that Four-Mile Cave was inaccessible to humans prior to 2009, due to boulders blocking the entrance. In addition, the petition provided no trend analysis for these caves. As stated earlier, the observation of the species in these locations does not mean the populations at these locations have not been impacted (in a way that is short of extirpation) or can withstand the long-term impacts that are expected to occur to karst invertebrate populations in developed areas or from human visitation.

In the species 5-year status review (Service 2009, p. 18), we said, "[a]lthough climate change was not identified as a threat to *T. reyesi* in the original listing document or in the recovery plan, the species' dependence on stable temperatures and humidity levels opens the possibility of climatic change impacting this species. Therefore, while it appears reasonable to assume that *T. reyesi* may be affected, we lack sufficient certainty to know how climate change will affect this species."

The petition states that "the use of small voids or 'mesocaverns' within the geologic formations known to support occupied caves mitigates the potential threat of climate change." We acknowledge that mesocaverns may provide some protection from fluctuations in temperature and humidity that may be induced by climate change. However, the presence of mesocaverns alone will likely not be sufficient to ameliorate all of the effects that climate change may pose to this species, especially in the long run.

Karst invertebrates depend on stable temperatures and high humidity (Barr 1968, p. 47; Mitchell 1971, p. 250). The temperatures in caves are typically the average annual temperature of the surface habitat and vary much less than the surface environment (Howarth 1983, p. 372; Dunlap 1995, p. 76). If average surface temperatures increase, this could result in increased in-cave temperatures, which could affect the Bone Cave harvestman.

Increased and/or more severe storms, as well as prolonged periods of high temperatures and drought between rainfall events, associated with anticipated climate change effects may also impact the cave environment. Changes in rainfall regimes may affect the harvestman in several ways, including directly either through flooding or indirectly by modifying their habitat or nutrient availability. Changes in rainfall regimes could (1) alter the moisture levels within the caves leaving them drier between floods, which could lead to desiccation of the Bone Cave harvestman; and (2) affect the amount and timing of nutrients washed into a cave, potentially resulting in longer periods between nutrient input. These changes to drier and less suitable conditions in the caves will likely cause the Bone Cave harvestman to retreat farther into mesocaverns and away from nutrients that are thought to be located in larger cave passages (Howarth 1987, pp. 5–7), causing individuals to spend more energy trying to acquire nutrients in an already stressed environment. In addition, caves in arid regions have been shown to have smaller invertebrate populations and diversity due to less moisture and nutrient availability (George Veni, National Cave and Karst Research Institute, pers. comm. 2010). Since the Bone Cave harvestman is also sensitive to these habitat parameters, it is reasonable to predict that the effects of climate change on these habitat parameters could affect its

populations in a similar manner despite the presence of mesocaverns.

Further, stochastic (random) events from either environmental factors (for example, severe weather) or demographic factors (which come from the chance events of birth and death of individuals) exacerbate threats to the species because of its small population size (Melbourne and Hastings 2008, p. 100). The risk of extinction for any species is known to be highly inversely correlated with population size (Pimm *et al.* 1988, pp. 774–775; O'Grady *et al.* 2004, pp. 516, 518). In other words, the smaller the population the greater the overall risk of extinction. Therefore, threats to the Bone Cave harvestman are exacerbated by its small population size, which makes it more vulnerable to existing threats.

Finding

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service (Services) use the rulemaking process in our administration of the Act, in particular section 4 of the Act. Section 4(b)(3) of the Act establishes deadlines and standards for making findings on petitions to conduct rulemakings under section 4. As stated above, the Services revised the regulations at 50 CFR 424.14 to clarify the procedures under which the Services evaluate petitions effective October 27, 2016 (81 FR 66462; September 27, 2016). We originally received the petition that is the subject of this document on June 2, 2014, with supplemental information received on October 6, 2016. We therefore evaluated this petition under the 50 CFR 424.14 requirements that were in effect prior to October 27, 2016, as those requirements applied when the petition and supplemental information were received.

We have reviewed the petition, including all accompanying materials, and

evaluated readily available, related information in our files. The results of the 2009 5-year review and the assessment of threats in the five factor analysis presented in this 90-day finding do not indicate that the original classification was made in error. The petitioners have primarily based their contention that the species can thrive in developed areas on information that we have previously considered and rejected while working on previous documents (Service 2009, 2012). Petitioners present limited new information, such as the fact that four occupied caves have been discovered since the 5-year status review. In addition, petitioners assert that seven other caves are occupied. However, we lack, and the petition did not provide, locality information or taxonomic verifications related to these potential additional locations of the species. The other arguments presented in the petition lack a large enough sample size to produce population trend information for the Bone Cave harvestman. The petition provided no trend analysis to indicate that this species can withstand the threats associated with development or climate change over the long term. In addition, these threats, particularly those related to development, appear to be increasing in severity. Based on our review and evaluation, we find that the petition does not present substantial scientific or commercial information indicating that the delisting of the Bone Cave harvestman may be warranted due to recovery, extinction, or error in the original scientific data at the time the species was classified or in our interpretation of the data.

Although this finding ends our formal consideration of the petition, we are in the process of conducting a species status assessment and 5-year status review. Specifically, section 4(c)(2)(A) of the Act requires us to review each listed species' status at least once every 5 years. On April 15, 2015, we published a notice in the Federal Register initiating

this review (80 FR 20241). The purpose of a 5-year review is to determine whether listed species should be removed from the list or changed in status under the Act. In this case, we are developing a species status assessment as a tool to inform the 5-year status review. The 5-year review will consider whether the species status has changed since the time of its listing or its last status review and whether it should be reclassified as threatened or delisted. We invite the public, including the petitioners and other interested parties, to submit new data and information for consideration in this ongoing process.

Much progress has been made toward recovery in the North Williamson and Jollyville Plateau Karst Fauna Regions. We encourage interested parties to continue to gather data and implement conservation actions across the range of the Bone Cave harvestman that will further assist with the conservation of this species. If you wish to provide information regarding the Bone Cave harvestman, you may submit your information or materials to the Field Supervisor, Austin Ecological Services Field Office (see **ADDRESSES**) at any time.

References Cited

A complete list of references cited is available on the Internet at *http://www.regulations.gov* and upon request from the Austin Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this document are staff members of the Austin Ecological Services Field Office.

Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: _____

_____

Director, U.S. Fish and Wildlife Service

Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: MAR 20 2017

James W. Kurth

James W. Kurth

Acting *Director, U.S. Fish and Wildlife Service*

Defense Exhibit 2

U.S. Fish & Wildlife Service

Why Save Endangered Species?

M003606

Since life began on Earth, countless creatures have come and gone, rendered extinct by naturally changing physical and biological conditions.

Since extinction is part of the natural order, and if many other species remain, some people ask: "Why save endangered species? Why should we spend money and effort to conserve them? How do we benefit?"

Congress answered these questions in the preamble to the Endangered Species Act of 1973, recognizing that endangered and threatened species of wildlife and plants "are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people." In this statement, Congress summarized convincing arguments made by scientists, conservationists, and others who are concerned by the disappearance of unique creatures. Congress further stated its intent that the Act should conserve the ecosystems upon which endangered and threatened species depend.

Although extinctions occur naturally, scientific evidence strongly indicates that the current rate of extinction is much higher than the natural or background rate of the past. The main force driving this higher rate of loss is habitat loss. Over-exploitation of wildlife for commercial purposes, the introduction of harmful exotic (nonnative) organisms, environmental pollution, and the spread of diseases also pose serious threats to our world's biological heritage.

Passenger pigeons once numbered in the billions but now exist only in museums.

Chip Clark/Smithsonian Institution

M003608

Conservation actions carried out in the United States under the Endangered Species Act have been successful in preventing extinction for 99 percent of the species that are listed as endangered or threatened. However, species loss on a global scale continues to increase due to the environmental effects of human activities.

Biologists estimate that since the Pilgrims landed at Plymouth Rock in 1620, more than 500 species, subspecies, and varieties of our Nation's plants and animals have become extinct. The situation in Earth's most biologically rich ecosystems is even worse. Tropical rainforests around the world, which may contain up to one half of all living species, are losing millions of acres every year. Uncounted species are lost as these habitats are destroyed. In short, there is nothing natural about today's rate of extinction.

Right: Former rainforest habitat

Below: Intact rainforest at dawn

CIA

CECB/BU Photo Library

Courtesy of Great Smoky Mountains National Park and the American Chestnut Foundation

Not too long ago, almost one quarter of the trees in the Appalachian forests were American chestnuts. They helped support not only wildlife but the people living among them. Chestnuts were an important cash crop for many families. As year-end holidays approached, nuts by the railroad car were sold and shipped to northeastern cities. Chestnut timber, strong and rot resistant, was prized for building barns, fences, furniture, and other products. This photograph of the Shelton family, taken around 1920, shows the size American chestnut trees once reached.

First detected in 1904, an Asian fungus to which native chestnuts had little resistance appeared in New York City trees. The blight spread quickly, and by 1950 the American chestnut was virtually extinct except for occasional root sprouts that also became infected. Organizations such as the American Chestnut Foundation are working with plant breeders to develop a disease resistant strain and restore it to the eastern forests.

Benefits of Natural Diversity

How many species of plants and animals are there? Although scientists have classified approximately 1.7 million organisms, they recognize that the overwhelming majority have not yet been catalogued. Between 10 and 50 million species may inhabit our planet.

None of these creatures exists in a vacuum. All living things are part of a complex, often delicately balanced network called the biosphere. The earth's biosphere, in turn, is composed of countless ecosystems, which include plants and animals and their physical environments. No one knows how the extinction of organisms will affect the other members of its ecosystem, but the removal of a single species can set off a chain reaction affecting many others. This is especially true for "keystone" species, whose loss can transform or undermine the ecological processes or fundamentally change the species composition of the wildlife community.

Chisos Mountain hedgehog

Tracy Brooks

Gray wolf

The gray wolf is one such keystone species. When wolves were restored to Yellowstone National Park, they started to control the park's large population of elk, which had been over consuming the willows, aspen, and other trees that grew along streams. The recovery of these trees is cooling stream flows, which benefits native trout, and increases nesting habitat for migratory birds. Beavers now have willow branches to eat, and beaver dams create marshland habitat for otters, mink, and ducks. Wolves even benefit the threatened grizzly bear, since grizzlies find it easier to take over a wolf kill than to bring down their own elk.

Contributions to Medicine

One of the many tangible benefits of biological diversity has been its contributions to the field of medicine. Each living thing contains a unique reservoir of genetic material that has evolved over eons. This material cannot be retrieved or duplicated if lost. So far, scientists have investigated only a small fraction of the world's species and have just begun to unravel their chemical secrets to find possible human health benefits to mankind.

No matter how small or obscure a species, it could one day be of direct importance to us all. It was "only" a fungus that gave us penicillin, and certain plants have yielded substances used in drugs to treat heart disease, cancer, and a variety of other illnesses. More than a quarter of all prescriptions written annually in the United States contain chemicals discovered in plants and animals. If these organisms had been destroyed before their unique chemistries were known, their secrets would have died with them.

A few hundred wild species have stocked our pharmacies with antibiotics, anti-cancer agents, pain killers, and blood thinners. The biochemistry of unexamined species is an unfathomed reservoir of new and potentially more effective substances. The reason is found in the principles of evolutionary biology. Caught in an endless "arms race" with other forms of life, these species have devised myriad ways to combat microbes and cancer-causing runaway cells. Plants and animals can make strange

M. Plotkin

The rosy periwinkle, a plant native to the island of Madagascar, has yielded powerful substances effective in treating childhood leukemia and other diseases.

The peeling bark of the Pacific yew, original source of the drug taxol.

Dave Powell/U.S. Forest Service

molecules that may never occur to a chemist. For example, the anti-cancer compound taxol, originally extracted from the bark of the Pacific yew tree, is "too fiendishly complex" a chemical structure for researchers to have invented on their own, said a scientist with the U.S. National Cancer Institute. Taxol has become the standard treatment for advanced cases of ovarian cancer, which strikes thousands of women every year. But until the discovery of taxol's effectiveness, the Pacific yew was considered a weed tree of no value and was routinely destroyed during logging operations.

Some of the most promising natural wonder drugs come from compounds not usually associated with healing: poisons. One pharmaceutical company is marketing a blood thinner based on the venom of the deadly saw-scaled viper. A protein from another Asian pit viper is being studied because it appears to inhibit the spread of melanoma cells, and a compound from the venom of some tarantula species may lead to new treatments for neurological disorders such as Parkinson's disease.

Tarantula

Jim Rorabaugh

Some farmers put up nest boxes to attract bats that consume harmful insects.

Merlin D. Tuttle/
Bat Conservation
International

Biodiversity and Agriculture

Many seemingly insignificant forms of life are beginning to show important benefits for agriculture. Farmers are using insects and other animals that prey on certain crop pests, as well as using plants containing natural-toxins that repel harmful insects. These are called "biological controls," and in many cases they are a safe, effective, and less expensive alternative to synthetic chemicals.

Thomas Jefferson once wrote that "the greatest service which can be rendered any country is to add a useful plant to its culture, especially a breadgrain." It has been estimated that there are almost 80,000 species

Texas wild rice

Sue Emery

of edible plants, of which fewer than 20 produce 90 percent of the world's food. If underutilized species are conserved, they could help to feed growing populations. One grain native to the Great Lakes States, Indian wild rice, is superior in protein to most domesticated rice, and its increasing commercial production earns millions of dollars annually. Crossing it with a related but endangered species, Texas wild rice, could result in a strain adaptable to other regions of the country.

Christopher Best

Walker's manioc is an endangered plant endemic to the Lower Rio Grande Valley of southern Texas and northeastern Mexico. It is closely related to an important crop plant, cassava, which is a staple food in many parts of the world. Walker's manioc could contain genes that provide salt, drought, cold, or disease resistance for strains of commercial cassava.

Ted Swem

Peregrine falcon

Environmental Monitors

Many individual species are uniquely important as indicators of environmental quality. The rapid decline in bald eagles and peregrine falcons in the mid-20th century was a dramatic warning of the dangers of DDT—a strong, once widely used pesticide that accumulates in body tissues. (It hampered fertility and egg-hatching success in these species.) In another example, lichens and certain plants like the eastern white pine are good indicators of excess ozone, sulfur dioxide, and other air pollutants. Species like these can alert us to the effects of some contaminants before more damage is done.

Freshwater mussels are also very effective environmental indicators. The eastern United States boasts the richest diversity of freshwater mussels in the world. These animals are filter feeders, drawing in water and straining out food particles. Their method of feeding helps to keep our waters clean. But because mussels

Richard Biggins

Fanshell mussel

filter material from the water, they are often the first animals to be affected by water pollution. They tend to accumulate whatever toxins, such as chemicals in agricultural and industrial runoff, are present in their habitat. Too much pollution can eliminate the mussels. Other threats to mussel populations include siltation, the introduction of competing nonnative mussels, stream channelization and dredging, and the impoundment of free-flowing streams and rivers. Today, most native freshwater mussel species are considered to be endangered, threatened, or of special concern.

Amber darter

J.R. Shute/Conservation Fisheries, Inc.

Ecosystem Services

As the pioneering naturalist Aldo Leopold once stated, "To keep every cog and wheel is the first precaution of intelligent tinkering." As we tinker with ecosystems through our effects on the environment, what unexpected changes could occur? One subject of increasing concern is the impacts these effects can have on "ecosystem services," which is a term for the fundamental life-support services provided by our environment. Ecosystem services include air and water purification, detoxification and decomposition of wastes, climate regulation, regeneration of soil fertility, and the production and maintenance of biological diversity. These are the key ingredients of our agricultural, pharmaceutical, and industrial enterprises. Such services are estimated to be worth trillions of dollars annually. Yet because most of these services are not traded in economic markets, they carry no price tags that could alert society to changes in their supply or declines in their functioning. We tend to pay attention only when they decline or fail.

John and Karen Hollingsworth

Wetlands, like those at the John Heinz National Wildlife Refuge near Philadelphia, clean water, control flooding, and provide quality wildlife habitat.

Keith Weller

Alpine pennycress

An emerging field called phytoremediation is an example of the ecosystem services provided by plants. Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil and sediment. Certain plant species known as metal hyperaccumulators have the ability to extract elements from the soil and concentrate them in the easily harvested plant stems, shoots, and leaves. The alpine pennycress, for example, doesn't just thrive on soils contaminated with zinc and cadmium; it cleans them up by removing the excess metals. In the home, houseplants under some conditions can effectively remove benzene, formaldehyde, and certain other pollutants from the air.

Laura Riley

Birdwatching at J.N. "Ding" Darling National Wildlife Refuge on Florida's Gulf Coast.

Other Economic Values

Some benefits of animals and plants can be quantified. For example, the Texas Parks and Wildlife Department calls birding "the nation's fastest growing outdoor recreation." It estimates that birders pump an estimated $400 million each year into the state's economy. A host of small rural towns host festivals to vie for the attention of these birders. Nationwide, the benefits are even more amazing. In a recent study (Birding in the United States: A Demographic and Economic Analysis), the U.S. Fish and Wildlife Service estimated that wildlife watching—not just bird watching—generated $85 billion in economic benefits to the nation in 2001.

Steve Hillebrand

Whooping cranes in Texas.

George Lavendowski

Attwater's greater prairie-chicken, another Texas bird.

Intangible Values

If imperiled plants and animals lack a known benefit to mankind, should we care if they disappear? If a species evolves over millennia or is created by divine intent, do we have a right to cause its extinction? Would our descendants forgive us for exterminating a unique form of life? Such questions are not exclusive to scientists or philosophers. Many people believe that every creature has an intrinsic value. The loss of plant and animal species, they say, is not only shortsighted but wrong, especially since an extinct species can never be replaced. Eliminating entire species has been compared to ripping pages out of books that have not yet been read. We are accustomed to a rich diversity in nature. This diversity has provided inspiration for countless writers and artists, and all others who treasure variety in the natural world.

Suzanne L. Collins/Center for North American Herpetology

M003623

San Francisco garter snake

Among its many values, wildlife is a source of inspiration. For example, the bird paintings by John James Audubon, such as this image of ivory-billed woodpeckers, are recognized as fine art. Once feared to be extinct, the ivory-bill was rediscovered recently in Arkansas.

In his story "The Bear," writer William Faulkner depicted a number of creatures that are now rare, including wolves, panthers, the ivory-billed woodpecker, and, of course, the animal now known as the Louisiana black bear.

USFWS

U.S. Fish & Wildlife Service
Endangered Species Program
4401 N. Fairfax Drive, Rm 420
Arlington, VA 22203

http://endangered.fws.gov/

July 2005

Cover photo: *Geranium arboreum*, an endangered Hawaiian plant.
© G.D. Carr

M003625

Defense Exhibit 3

National Cave and Karst Research Institute

21 March 2017

Michael Warriner, Supervisor
U.S. Fish and Wildlife Service
Austin Ecological Services
10711 Burnet Rd., Suite 200
Austin, TX 78758
Via e-mail: michael_warriner@fws.gov

Re: Commercial value of endangered karst invertebrates

Dear Mr. Warriner,

This letter responds to the issue about the commercial value of endangered karst invertebrate species that are federally listed in Texas, with emphasis on the Bone Cave harvestman (*Texella reyesi*). I am writing in two capacities. First, I am the Executive Director of the National Cave and Karst Research Institute (NCKRI), which was created by the US Congress in 1998 and mandated to:

1) further the science of speleology;
2) centralize and standardize speleological information;
3) foster interdisciplinary cooperation in cave and karst research programs;
4) promote public education;
5) promote national and international cooperation in protecting the environment for the benefit of cave and karst landforms; and
6) promote and develop environmentally sound and sustainable resource management practices.

Second, I have conducted extensive research and provided management guidance to the US Fish and Wildlife Service (USFWS) for the past 29 years since the karst invertebrates were listed. Most of this work occurred prior to my employment by NCKRI when I ran my own company that specialized in cave and karst environmental consulting.

While the issue in question focuses on the Bone Cave harvestman, my reply will apply to the Bone Cave harvestman and all of the listed karst invertebrates in Texas.

In general, the Bone Cave harvestman and all endangered karst invertebrates are easily dismissed as having no commercial value. They are tiny, relatively few in observable number, produce no known vital ecological services to humanity, and are difficult to observe in their dark, underground environments. However, this view point is quite limited and misses several important commercial contributions that can be classified into the following four categories that I elaborate on below:

- Research
- Conferences and publications

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- Environmental/water supply protection
- Public education/tourism

Research

Study of the all of the listed karst species invertebrate and other species in their ecosystems began decades before the species were listed. Some of those studies were the foundation for the listings. Since the listings, studies of the karst ecosystems, not just the Bone Cave harvestman and the other listed karst invertebrate species, have intensified tremendously. I emphasize the importance of the ecosystems because the listed species do not occur in isolation from other animals. Understanding the ecology, life cycles, and conservation needs of the Bone Cave harvestman and other listed karst invertebrates requires an equal understanding of the non-listed species which share their habitat. In my experience, this is best illustrated by my work for USFWS that delineated "Karst Fauna Regions" based on the distribution of the listed species and associated non-listed species that defined regions of similar habitat in the Bexar (Veni, 1994, 2002) and Travis and Williamson County areas (Veni and Associates, 1992; Veni and Martinez, 2007). These Karst Fauna Regions stand as the foundation on which critical habitat and many other conservation measures are based (e.g., USFWS 1994, 2012).

The listing of the species focused biological attention on the critical need to study the invertebrates and associated non-listed species. My funded biological consulting projects alone included taxonomic specialists in the various animal groups who lived in nine US states (California, Iowa, Missouri, New Hampshire, New York, North Carolina, Ohio, Texas, and Virginia) and two countries (Canada and USA), as an example of interstate and intrastate commerce. Most of my projects were funded by private corporations and individuals, as well as by public agencies. I am aware of dozens of other consulting studies on the listed and associated non-listed species, including the listed Bone Cave harvestmen, and would not be surprised if such studies totaled in the hundreds. Scientists have been funded by diverse interstate and intrastate sources of grants and contracts to study these species. I am aware of published research on the listed and associated non-listed fauna in their ecosystems that were collectively supported by grants and contracts provided by:

- Austin Community Foundation (Bendik et al., 2013)
- Cave Research Foundation (Krejca, 2009)
- City of Austin (Bendik et al., 2013)
- Engineer Research and Development Center (Taylor and Krejca, 2005)
- La Cantera Development Company (Paquin and Hedin, 2004; White et al., 2009)
- Marist College (Espinasa et al., 2016)
- National Speleological Society (Krejca, 2009)
- North American Native Fishes Association (Krejca, 2009)
- P.E.O. Presidential Endowed Scholar Award (Krejca, 2009)
- Phi Kappa Phi (Krejca, 2009)
- Phi Sigma Biological Honor Society (Bendik et al., 2013)
- Sigma Xi (Krejca, 2009)

- Texas Department of Transportation (Paquin and Dupérré, 2009)
- Texas Parks and Wildlife Department (Bendik et al., 2013)
- University of Arizona (Gomez et al., 2016)
- University of Texas at Arlington (Bendik et al., 2013)
- University of Texas at Austin (Krejca, 2009)
- University of Texas at Austin Environmental Studies Institute (Krejca, 2009)
- University of Texas at Austin Institute for Latin American Studies (Krejca, 2009)
- University of Texas at Austin Zoology Department (Krejca, 2009)
- US Army (Taylor and Krejca, 2005)
- US Fish and Wildlife Service (Bendik et al., 2013; Paquin and Hedin, 2004; White et al., 2009)
- US National Science Foundation (Bendik et al., 2013; Gomez et al., 2016)

One important aspect of the above research is that it adds to the repository of human knowledge. History contains many examples of how pure research of no apparent commercial value was later found to have direct, broad application for practical commercial purposes (e.g. the importance of insulin to relieving diabetes). The proverbial and perhaps actual cure to cancer and many other human needs may be discovered through this foundational research on the listed karst invertebrates.

Conferences and publications

I am not aware of any conferences dedicated to the listed karst invertebrates. The Austin Field Office of the USFWS holds occasional "Karst Conservation Initiative" workshops and seminars that are attended by land managers, scientists, consultants, and students throughout the region.

In contrast, I am aware of a least 18 papers on the listed invertebrates and associated species presented at the 15th International Congress of Speleology, which was held in Kerrville, Texas in 2009 (White, 2009). Most of these were offered at a special symposium: Protection and Management of Rare and Endangered Subterranean Fauna. Dozens of other papers have been presented at other conferences and published in professional journals. The most focused publications on the species in question are the Texas Speleological Monograph series published by the Texas Memorial Museum, with issue numbers 1, 3, 5, 6, and 7 being especially notable as *Studies on the Cave and Endogean Fauna of North America, I-V*.

Environmental/water supply protection

In 2000, the citizens of the City of San Antonio voted to increase their taxes to raise $45 million to acquire environmentally sensitive land. After those funds were expended, they voted again but to raise $90 million in 2005, and again in 2010 for another $90, and most recently approving $100 million in 2015 (City of San Antonio, 2017) by a majority of nearly 80%.

The environmentally sensitive areas of interest were primarily over the recharge zone of the Edwards Aquifer, where this sole source water supply is naturally replenished by

rainfall. Much of this area overlaps with habitat of several of the listed karst invertebrates. A similar program was enacted in the City of Austin, but I am focusing on San Antonio because I was highly involved with the project as a member of the Scientific Evaluation Team that created the model to identify the most preferred lands to acquire. A key element of that model included the areas where endangered species were known, raising their value in importance in protecting the single most of important economic resource of that region—the water supply for nearly 2 million people (Veni et al., 2001).

These popular actions were initiated by citizens who were frustrated by the State's perceived limitations on protecting the Edwards Aquifer from urbanization. Acquisition of the land by purchase and easement proved a solution to the limited power of regulations. Similarly, although indirectly, numerous properties that were preserved to protect populations of karst invertebrates, also protect the quality and quantity of water that recharges the Edwards Aquifer in the San Antonio and Austin areas. Like the human species, the karst invertebrates require an adequate volume of water and that it be clean of the chemicals that pollute urban runoff. The volume of water replenishing the aquifer through these preserves could be calculated, and its commercial value determined. In addition to clean water, the air-filtering capacity of the abundant trees in these protected areas could be calculated. Two direct interstate and intrastate commercial values to the clean Edwards Aquifer water include commercial bottling companies (e.g. Artesia Springs water and Lone Star Brewing) and food sales (e.g. Pace Foods).

Public education/tourism

Several of the properties acquired for environmental and water protection, including protection of the listed karst invertebrates, are now parks and other publically accessible open spaces that enhance the quality of life in those communities. I'm not aware of any studies that have quantified how many people moved to those cities or into adjacent neighborhoods to enjoy those benefits, but expect they could be determined.

Sun City in Williamson County, Texas, prides itself on its lack of property fences and abundant freely accessible green spaces, yet many of those green spaces were set aside to protect the listed karst invertebrates, including the Bone Cave harvestman. Many of the homeowners may not be aware of the invertebrates, but they were willing to pay a premium for their homes next to those karst preserves. I can't help but believe that out-of-town visitors to such homes may stay a little longer in the area, infusing more of their income into the local economies, because of the amenities resulting from these protected endangered species areas. The Sun City Corporation has requested the Texas Speleological Survey to produce a book on the caves of Sun City that it could distribute to its residents. The book is in production.

While the listed karst invertebrates are not generally observable by the public, there are some locations where they might be seen. Inner Space Cavern is home to the Bone

Cave harvestman and hosts tens of thousands of visitors each year. I do not recall ever hearing that the owners of the cave advertise that fact, but I expect that if they did that it may increase visitation.

In contrast, the Texas Cave Management Association advertises on its website (http://www.tcmacaves.org/robberbaron/index.php) and on-site kiosk the presence of two endangered invertebrates in Robber Baron Cave, *Texella cokendolpheri* which is similar to the Bone Cave harvestman, and the blind spider *Cicurina baronia*. Hundreds of people are led through the cave each year, most of whom make donations to the nonprofit association to learn about the cave, its history, and inhabitants.

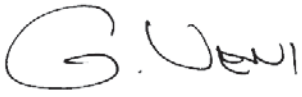
Further, at the National Cave and Karst Research Institute I have an exhibit plan for our museum that is in development. It includes a karst species viewing area. To the best of my knowledge, this will be the first exhibit where the general public can directly view and learn about karst invertebrate species, which will be concurrently studied by institute staff to learn more about the species' life cycles and to how to captive breed them in case of catastrophic loss in their native habitat. The listed karst invertebrates are not considered for display initially, but potentially at a later time when captive raising and display of related non-listed species proves that the listed species can be contained and raised safely. Generally over 400,000 people each year visit Carlsbad Caverns National Park, which is located near the institute, and I anticipate that many of those people will also visit the national cave and karst museum and science center we are creating.

Closing

I am not an economist and am not qualified to quantify the commercial economic value of the listed karst invertebrates. However, I believe I have shown that there is considerable and diverse direct, indirect, and potential commercial value to the species.

If you have questions or need additional information, please let me know.

Sincerely,



George Veni, Ph.D.
Executive Director

References

Bendik, Nathan F, Jesse M. Meik, Andrew G. Gluesenkamp, Corey E. Roelke, and Paul T. Chippindale. 2013. Biogeography, phylogeny, and morphological evolution of central Texas cave and spring salamanders. BMC Evolutionary Biology 2013, 13: 201, http://www.biomedcentral.com/1471-2148/13/201.

City of San Antonio. 2017. About the Edwards Aquifer. https://www.sanantonio.gov/EdwardsAquifer/About

Espinasa, Luis, Nicole D. Bartolo, Danielle M. Centone, Charisse S. Haruta, and James R. Reddell. 2016. Revision of genus *Texoreddellia* Wygodzinsky, 1973 (Hexapoda, Zygentoma, Nicoletiidae), a prominent element of the cave-adapted fauna of Texas. Zootaxa, 4126(2): 221–239, http://doi.org/10.11646/zootaxa.4126.2.3

Gómez, R. Antonio, James Reddell, Kipling Will, and Wendy Moore. 2016. Up high and down low: molecular systematics and insight into the diversification of the ground beetle genus *Rhadine* LeConte. Molecular Phylogenetics and Evolution 98: 161–175

Krejca, Jean K. 2009. New records for *Cirolanides texensis* Benedict, 1896 (Isopoda: Cirolanidae), including possible extirpations at impacted Texas caves. Cave and Karst Science, 35(1): 41-46.

Pierre Paquin & Nadine Dupérré. 2009. A first step towards the revision of *Cicurina*: redescription of type specimens of 60 troglobitic species of the subgenus *Cicurella* (Araneae: Dictynidae), and a first visual assessment of their distribution. *Zootaxa,* Magnolia Press, 67 pp.

Paquin, P. and M. Hedin. 2004. The power and perils of 'molecular taxonomy': a case study of eyeless and endangered *Cicurina* (Araneae: Dictynidae) from Texas caves. Molecular Ecology, 13: 3239-3255, doi: 10.1111/j.1365-294X.2004.02296.x.

Taylor, Steven J., and Jean K. Krejca. 2005. Foraging Range and Habitat Use of *Ceuthophilus secretus* (Orthoptera: Rhaphidophoridae), a Key Trogloxene in Central Texas Cave Communities. The American Midland Naturalist, 154: 97–114.

US Fish and Wildlife Service. 1994. Recovery plan for endangered karst invertebrates in Travis and Williamson counties, Texas. Albuquerque, New Mexico. 154 pp.

US Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; designation of critical habitat for nine Bexar County, TX, invertebrates. Federal Register, 70(30): 8450-8523.

Veni, George. 1994. Geologic controls on cave development and the distribution of endemic cave fauna in the San Antonio, Texas, region. Report prepared for Texas Parks and Wildlife Department and U.S. Fish and Wildlife Service, George Veni and Associates, San Antonio, Texas. 99 pp.

Veni, George. 2002. Delineation of hydrogeologic areas and zones for the management and recovery of endangered karst invertebrate species in Bexar County, Texas. Report for the U.S. Fish and Wildlife Service, Austin, Texas, George Veni and Associates, San Antonio, Texas, 75 pp.

Veni, George, Joe Chapa, Geary Schindel, Kirk Nixon, and Dan Stone. 2001. GIS modeling of significant karst areas for purchase and protection. 15th National Cave and Karst Management Symposium, Tucson, Arizona, USDA-Forest Service, pp. 179-185.

Veni, George, and Cecilio Martinez. 2007. Revision of karst species zones of the Austin, Texas, area. Report of the Texas Parks and Wildlife Department, Austin, Texas, George Veni and Associates, San Antonio, Texas, 45 pp.

Veni and Associates, George. 1992. Geologic controls in cave development and the distribution of cave fauna in the Austin, Texas, region. Report for the U.S. Fish and Wildlife Service, Austin, Texas, 77 pp.

White, Kemble, Gregg R. Davidson, Pierre Paquin. 2009. Hydrologic evolution of the Edwards Aquifer recharge zone (Balcones fault zone) as recorded in the DNA of eyeless *Cicurina* cave spiders, south-central Texas. Geology, 37(4): 339-342.

White, William B., ed. 2009. Proceedings of the 15th International Congress of Speleology. National Speleological Society, Huntsville, Alabama, 3 vols.